ACTIVITY ANALYSIS, FALL DETECTION AND RISK ASSESSMENT SYSTEMS AND METHODS

CROSS REFERENCE TO RELATED APPLICATION

The present non-provisional utility application claims priority under 35 U.S.C. §119(e) to co-pending provisional applications, including Application No. 61/687,608 entitled "Activity Analysis, Fall Detection, and Risk Assessment Using Depth Camera for Eldercare and Other Monitoring Applications" filed on Apr. 27, 2012, and which is hereby incorporated by reference here; Application No. 61/649,770 entitled "Activity Analysis, Fall Detection And Risk Assessment Systems And Methods" filed on May 21, 2012, and which is hereby incorporated by reference herein; and Application No. 61/788,748 entitled "Activity Analysis, Fall Detection And Risk Assessment Systems And Methods" filed on Mar. 13, 2013, and which is hereby incorporated by reference herein.

FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

This invention was made with government support under grant number 0931607awarded by the National Science Foundation. The government has certain rights in the invention.

TECHNICAL FIELD

The present invention relates to methods and systems for activity monitoring of a patient, and more specifically, to methods and systems for obtaining measurements of temporal and spatial gait parameters of the patient for use in health risk assessment.

BACKGROUND

Human activity analysis from video is an open problem that has been studied within the areas of video surveillance, homeland security, and eldercare. For example, the monitoring of human activity is often employed in the medical industry to detect any abnormal or dangerous events, such as falls and/or the risk of falls for a patient. Various parameters, such as gait parameters and/or other locomotive measurements corresponding to a medical patient, are often monitored and considered indispensable in the diagnosis of frailty and fall risk, and in particular, when providing medical care for the elderly.

Falls are a significant issue among the elderly. For example, it is estimated that between 25-35% of people 65 years and older fall each year, and many of such falls result in serious injuries, such as hip fractures, head traumas, and the like. Moreover, the medical costs associated with such falls are astronomical. In the year 2000, it is estimated that over $19 billion dollars were spent treating fall-related injuries for the elderly. Such costs do not account for the decreased quality of life and other long term effects often experienced by many elderly patients after suffering a fall.

Thus, a low-cost monitoring system that would allow for continuous, standardized assessment of fall risk may help address falls and the risk of falls among older adults. Moreover, to enable older adults to continue living longer, in particular, in an independent setting, and thus reduce the need for expensive care facilities, low-cost systems are needed that detect both adverse events such as falls, and the risk of such events.

It is with these concepts in mind, among others, that various aspects of the present disclosure were conceived.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features, and advantages of the present disclosure set forth herein will be apparent from the following description of exemplary embodiments of those inventive concepts, as illustrated in the accompanying drawings. It should be noted that the drawings are not necessarily to scale; however, the emphasis instead is being placed on illustrating the principles of the inventive concepts. Also in the drawings, the like reference characters refer to the same parts throughout the different views. The drawings depict only exemplary embodiments of the present disclosure and, therefore, are not to be considered limiting in scope.

FIG. **1** is a block diagram illustrating a computing environment for obtaining one or more parameters to perform health risk assessments, according to aspects of the present disclosure.

FIG. **2** is a block diagram illustrating an example living unit, according to aspects of the present disclosure.

FIG. **3** is a block diagram illustrating a remote device, according to aspects of the present disclosure.

FIG. **4** is a flowchart illustrating an example for obtaining temporal and spatial gait parameters for performing health risk assessments, according to aspects of the present disclosure.

FIG. **5** is a flowchart illustrating walk sequences, according to aspects of the present disclosure.

DETAILED DESCRIPTION

Aspects of the present disclosure include methods and corresponding systems for performing health risk assessments for a patient in the home environment. In various aspects, depth image data for a medical patient is obtained and subsequently used to generate one or more parameters, such as temporal and spatial gait parameters. Subsequently, the generated parameters may be used with other medical information related to the patient, such as electronic health records, to perform various health risk assessments, such as for example, alerting health care professionals of alarming trends or other health risks associated with the patient.

Falls represent a substantial health risk among the elderly, as the risk of falls generally increases with age. It is estimated that one out of every three older adults (age 65 and over) falls each year, many of which suffer serious injuries, such as hip fractures, head traumas, etc. Typically, the result of such falls is a reduction in a person's gait ability, such as a reduction in mobility and independence, all of which may ultimately increase the risk of early death. The causes of such falls are known as "risk" factors. Although, generally, no single risk factor can be considered the single cause of a given fall, the greater the number of risk factors to which an individual is exposed, the greater the probability of a fall and the more likely the results of the fall will threaten the person's independence.

Research has shown that gait parameters, which describe the pattern of movement in animals and humans, are indispensable in assessing risk factors, making fall risk assessments, the diagnosis of fall risk, or the like. For example, studies have indicated that gait parameters may be predictive of future falls and adverse events in older adults and, further,